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## **PREFATORY NOTE**

ETSI has constituted stable and consistent documents which give specifications for the implementation of the European Cellular Telecommunications System. Historically, these documents have been identified as "GSM recommendations".

Some of these recommendations may subsequently become Interim European Telecommunications Standards (I-ETSS) or European Telecommunications Standards (ETSS), whilst some continue with the status of ETSI-GSM Technical Specifications. These ETSI-GSM Technical Specifications are for editorial reasons still referred to as GSM recommendations in some current GSM documents.

The numbering and version control system is the same for ETSI-GSM Technical Specifications as for "GSM recommendations".

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## 0. SCOPE

The scope of this report is to give guidelines concerning the specifications of a Mobile Services Switching Centre (MSC). In the case of discrepancy between this report and the approved core GSM recommendations the latter shall prevail.

The different functions provided by the MSC are identified with an indication of the relevant recommendations where the definitive specifications can be found. It should be noted that this report gives example PLMN configurations for the purposes of indicating the most general routing and interworking scenarios. These example PLMN configurations shall not be interpreted in such a way as to constrain a network topology, since the internal routing within a country remains a national matter. For each function, an indication is given as to whether it is mandatory or optional.

The purpose of this report is to give an overview of the MSC functions needed to implement the GSM system, in order to help both the administrations/operators in the procurement of their equipments and the manufacturers tendering the MSC.

A list of the contents which may be found in a national specification for such equipment is given as an appendix to this report. Note that some items in this list are not specified by GSM, but are left to the discretion of the operators.

## 1. INTRODUCTION

The MSC constitutes the interface between the Base Station System (BSS) and the fixed networks. It is a digital exchange able to perform all necessary functions needed to handle the calls to and from mobile subscribers located in the MSC area. The architecture of the GSM system is described in Recommendation GSM 03.02.

The main difference between a fixed exchange and an MSC is that the MSC has additional functions to cope with the mobile nature of the subscribers. The MSC complies with the Q.500 series CCITT Recommendations.

The MSC ensures the correct interworking between the signalling used in the fixed network (normally CCITT No.7), the signalling used at the base station interface and the CCITT No.7 Mobile Application Part (MAP) used between the GSM PLMN functional entities.

## 2. MSC FUNCTIONS

The functional division between the BSS and the MSC is specified in Recommendation GSM 08.02.

In addition to the normal functions provided by a local exchange in the fixed network, the MSC must perform the following functions:

- a) the specific call handling function necessary to cope with the mobile nature of the subscribers, e.g. paging
- b) the management of the radio resource during a call : indication to the BSS about the type of radio channel needed to support the different phases of a communication (e.g. DCCH, TCH).
- c) the management of the signalling protocol with the BSS: the protocol used is specified in the 08 series Recommendations;
- d) location registration: this procedure needs to be handled by the MSC to ensure interworking between the MS and the Visitor Location Register (VLR) (see Recommendation GSM 03.12)
- e) the hand-over procedure: when a MS moves to a location area controlled by another BSS during a call, the MSC must perform the transfer of the connection to a new BSS located in its own area or controlled by another MSC (see Recommendation GSM 03.09);
- f) to ensure the routing of an incoming call to the called mobile, an interrogation of the Home Location Register (HLR) must be performed to obtain the roaming number allocated to that MS. If the fixed exchanges are unable to perform this interrogation, the call is routed to an MSC which then acts as a gateway MSC (see Recommendation GSM 03.04) : this gateway MSC function may be implemented in all the MSCs or in some of them. This HLR interrogation function will also need to be performed by an MSC when a MS calls another MS in the same or in some cases another PLMN.
- g) to perform the exchange of signalling information with the other mobile functional entities (e.g. VLR, HLR, other MSC), via the Mobile Application Part (see Recommendation GSM 09.02);
- h) to handle the interworking functions for data and Dual Tone Multi-Frequency signalling (DTMF) required since the speech encoder is not transparent.
- i) to support the transfer of encryption parameters between VLR and BSS.
- j) to control the operation of echo cancellors (see Recommendation GSM 09.03 and 03.50).
- k) to support the Short Message Service (SMS): the requirements of the MSC to support this service are specified in GSM Recommendation 03.40.



### 3. CALL ESTABLISHMENT

The purpose of this chapter is to give an overview of the functions of the MSC in establishing calls from the GSM Mobile Station (MS) or to the MS.

This chapter is based on requirements of the GSM recommendations shown in table 3.1.

Table 3.1 Associated GSM recommendations

GSM Rec.	Title
03.02	Network Architecture
03.03	Numbering, Addressing and Identification
03.04	Signalling Requirements Relating to Routing of Calls to Mobile Subscribers
09.01	General Aspects of PLMN Interworking
09.03	Signalling Requirements on Interworking between the ISDN or PSTN and a PLMN
09.07	General requirements on Interworking between the PLMN and the ISDN or PSTN
09.09	Detailed Signalling Interworking within the PLMN and with the PSTN/ISDN

The MSC performs call handling functions to and from the MSs. Call establishment is described here only from the MSC point of view. Different routing methods in the fixed ISDN/PSTN are represented in GSM Recommendation 03.04.

The main assumption of this chapter is that the fixed network (PSTN or ISDN) is not able to do the routing of calls to the MS by interrogating the HLR, i.e. the optimum routing scenario is not described here. The interrogation to obtain the actual location of the MS is performed by the Gateway MSC, which forwards the call to the MSC where the MS is located (Recommendation GSM 03.04). This assumption exposes all functions ever needed at the originating MSC, terminating MSC and Gateway MSC (GMSC). However, there are more sophisticated routing principles described in recommendation GSM 03.04. In these methods the interrogation of the HLR is done by the fixed network as early as possible during the call establishment. Re-routing can also be used. As a consequence the functions of the GMSC are reduced and better utilization of circuits is achieved, which makes these methods more attractive in the long run.

The three evolutionary steps of routing methods employed might be such that in the first phase call forwarding via GMSC is employed. In the next phase re-routing of calls at GMSC can be used, which requires some new functions in the GMSC and preceding fixed network exchanges. Finally in the third phase the interrogation of the HLR by the ISDN/PSTN represents the most sophisticated method. In this chapter the description of call establishment is based on the call forwarding method.

Table 3.2 Call establishment cases

Call from	Call to	PLMN	PSTN	PDN	ISDN
PLMN		3.1.1 3.2.1	3.1.2	3.1.3	3.1.4
PSTN		3.2.2			
PDN		3.2.3			
ISDN		3.2.4			

No network interworking solution with the GSM PLMN and the ISDN or the PSTN has been taken into account here. The GSM PLMN can be interconnected directly to the ISDN and the PSTN, or it can be connected to the PSTN via the ISDN (recommendation GSM 09.01).

The most typical call establishment cases, are described in the sections given in table 3.2.

3.1. MS ORIGINATING CALL

3.1.1. Call to PLMN

3.1.1.1. Call to an MS of the same PLMN

Figure 3.1 shows a call from an MS to an MS of the same GSM PLMN.

During call establishment the originating exchange MSC-A analyzes part of the called subscriber ISDN number. It detects from the National Destination Code (NDC) that the number is a Mobile Subscriber ISDN number belonging to an MS of the same PLMN. MSC-A then interrogates the HLR to obtain the Mobile Station Roaming number. According to the roaming number the call is routed to MSC-B as described in section 3.2.1.1.

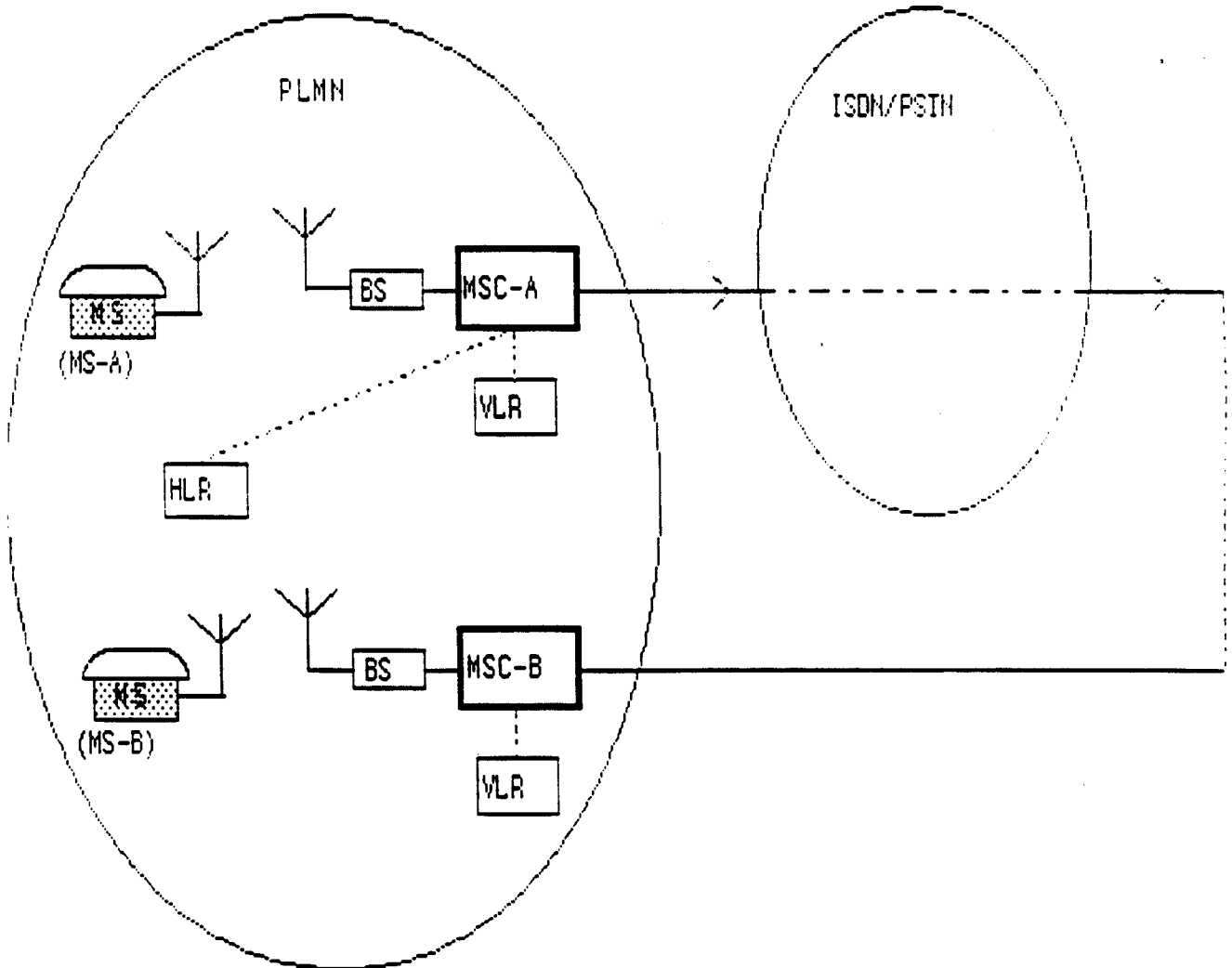


Figure 3.1. Call from an MS to an MS of the same GSM PLMN

A MSC internal call is a special case of figure 3.1 where a call from MS-A to MS-B is shown. In this case the called MS is located in the same MSC area as the calling MS. During call establishment MSC-A identifies that the dialled Mobile Subscriber ISDN number refers to a MS of the same PLMN. MSC-A interrogates the HLR of the called MS. It receives a Mobile Station Roaming Number leading to itself. An internal connection from MS-A to MS-B within the MSC is established. No ISDN/PSTN connection is thus needed. The MSC acts both as an originating and terminating exchange.

3.1.1.2. Call to a MS of another PLMN in the same country

Figure 3.2 shows a call from a MS terminating in a MS of another GSM PLMN in the same country.

After analyzing part of the called subscriber ISDN number the originating exchange, MSC-A detects from the National Destination Code (NDC) that the call is headed for another GSM PLMN of the same country. MSC-A interrogates the HLR of the other PLMN and routes the call, according to the MSRN, to MSC-B as described in section 3.2.1.2.

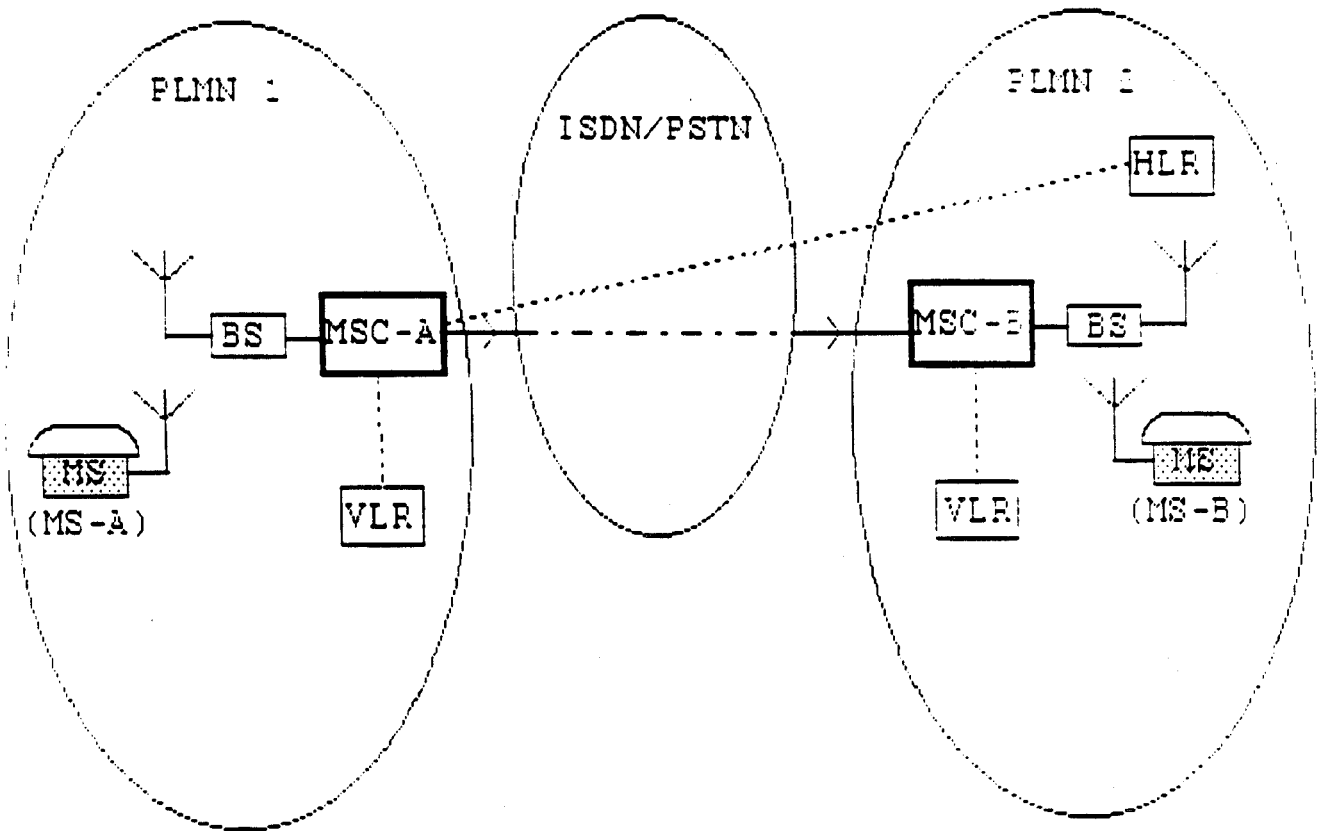


Figure 3.2. Call from a MS to a MS of another GSM PLMN in the same country.

3.1.1.3. Call to a MS of another PLMN in another country

Figure 3.3 shows a call from a MS terminating in a MS of another GSM PLMN in another country.

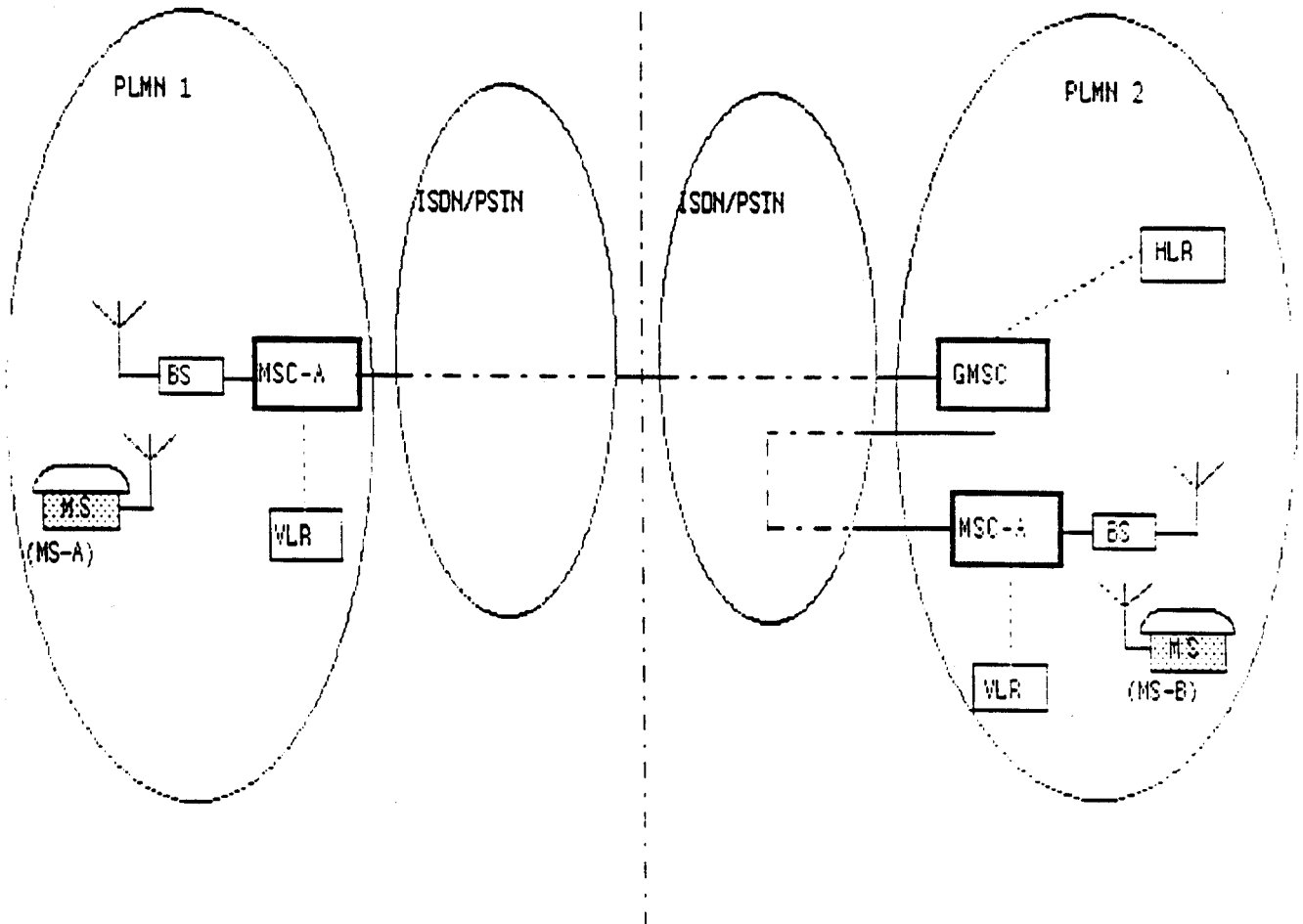


Figure 3.3. Call from a MS to a MS of another GSM PLMN in another country

After analyzing part of the called subscriber ISDN number the originating exchange MSC-A detects from the international prefix that the call is headed for another country. MSC-A routes the call directly to the international switching centre of the ISDN/PSTN, which sets up the connection to MS-B as described in section 3.2.1.3.

3.1.2. Call to PSTN

Figure 3.4 shows a call from a MS to a PSTN subscriber.

MSC-A acts as an outgoing exchange. It analyses part of the called subscriber PSTN number. If the international prefix has been dialled MSC-A routes the call to an ISC (International Switching Centre). Otherwise, if MSC-A detects from the Trunk Code (CCITT E. 163) that the number is a fixed network national PSTN number and not a GSM PLMN number, it routes the call to the PSTN, which sets up the connection to MS B.

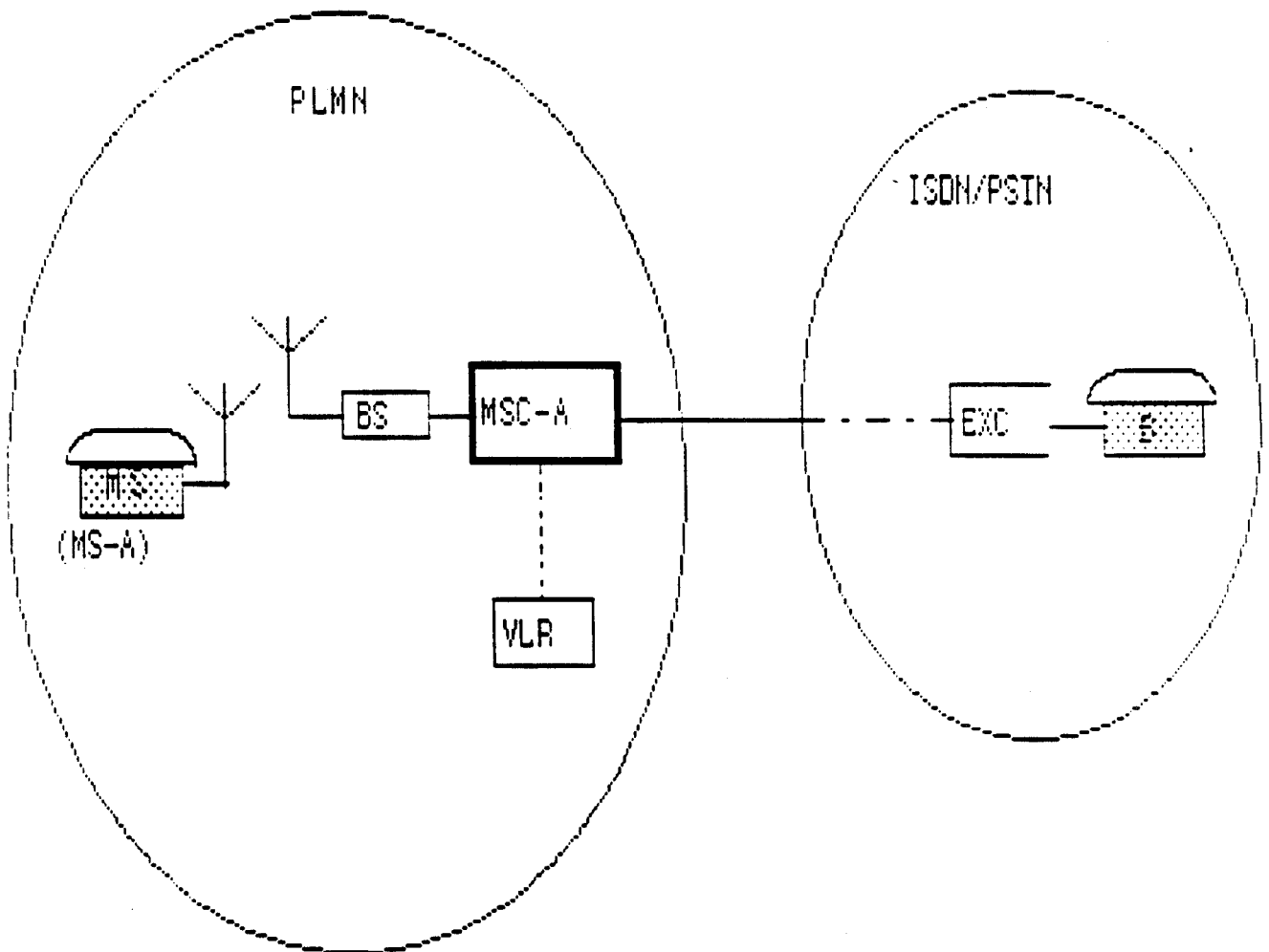


Figure 3.4. Call to ISDN/PSTN.

### 3.1.3. Call to ISDN

Figure 3.4 shows a call from a MS to an ISDN subscriber.

MSC-A acts as an outgoing exchange. It analyses part of the called subscriber ISDN number. If the international prefix has been dialled MSC-A routes the call to an ISC. Otherwise, if MSC-A detects from the National Destination Code (CCITT E.164) that the number is a fixed network national ISDN number and not a GSM PLMN number, it routes the call to the ISDN, which sets up the connection to MS B.

### 3.1.4. Call to PDN

Interworking between the GSM PLMN and the PSPDN will be defined in GSM Recommendations 09.05 and 09.06. Interworking between the GSM PLMN and the CSPDN will be defined in GSM Recommendation 09.04. The routing of calls to PDNs is described in 03.70.

## 3.2. MS TERMINATING CALL

### 3.2.1. Call from PLMN

#### 3.2.1.1. Call from a MS of the same PLMN

Figure 3.1 shows a call terminating in a MS from a MS of the same GSM PLMN.

During the call establishment phase the location of the called MS has been previously determined. The call is routed to MSC-B according to the Mobile Station Roaming Number. MSC-B acts as an incoming exchange. It pages MS-B and sets up the connection to it. For ISDN/PSTN exchanges the call is a normal transit call. The connection between MSC-A and MSC-B may go through several national transit exchanges of the ISDN/PSTN.

The called MS may have roamed to another PLMN. However, the operation of MSC-A and MSC-B is the same, only the connection between the MSCs via the ISDN/PSTN becomes a connection between GSM PLMNs. The connection may go through several national or international transit exchanges of the ISDN/PSTN.

If the called MS is located in the same MSC area as the calling MS, the call is an internal MSC call, which is described in section 3.1.1.1.

3.2.1.2. Call from a MS of another PLMN in the same country

Figure 3.2 shows a call terminating in a MS from a MS of another GSM PLMN in the same country.

The originating MSC has interrogated the location of the called MS and routes the call to MSC-B. MSC-B then acts as an incoming exchange. It pages the called MS and sets up the call to MS-B.

3.2.1.3. Call from a MS of another PLMN in another country

Figure 3.3 shows a call terminating in a MS from a MS of another GSM PLMN in another country.

The originating MSC has not been able to determine the location of the called MS. For this reason the call is first routed from MSC-A to the Gateway MSC (GMSC) of the terminating PLMN. The connection between MSC-A and the GMSC may go through several national and international transit exchanges of the ISDN(PSTN). The GMSC performs the interrogation of the Home Location Register (HLR) to know the MSC area where the called MS is located. The HLR sends back to the GMSC the Mobile Station Roaming Number, which is used to set up the call to MSC-B. MSC-B acts as an incoming exchange. It pages the called MS and sets up the call to MS-B.

The connection between the GMSC and MSC-B may be in the national ISDN/PSTN. If MS-B has roamed to a third PLMN the connection may be made in the ISDN/PSTN nationally or internationally. The connection between the GMSC and MSC-B may go through several national or international transit exchanges of the ISDN/PSTN.



3.2.2. Call from PSTN

Figure 3.5 shows a call terminating in a MS from a PSTN subscriber.

It has been assumed that the PSTN does not have the ability to interrogate the HLR. As a consequence call set-up has to be made first to the GMSC in the terminating PLMN. The GMSC asks the HLR to return the Mobile Station Roaming Number, which is then used for routing the call to MSC-B. MSC-B pages MS-B and sets up the call to it. The connection between the GMSC and MSC-B may be in the national ISDN/PSTN or in the international ISDN/PSTN if MS-B has roamed to a third PLMN. The connection between the GMSC and MSC-B may go through several national or international transit exchanges of the ISDN/PSTN.

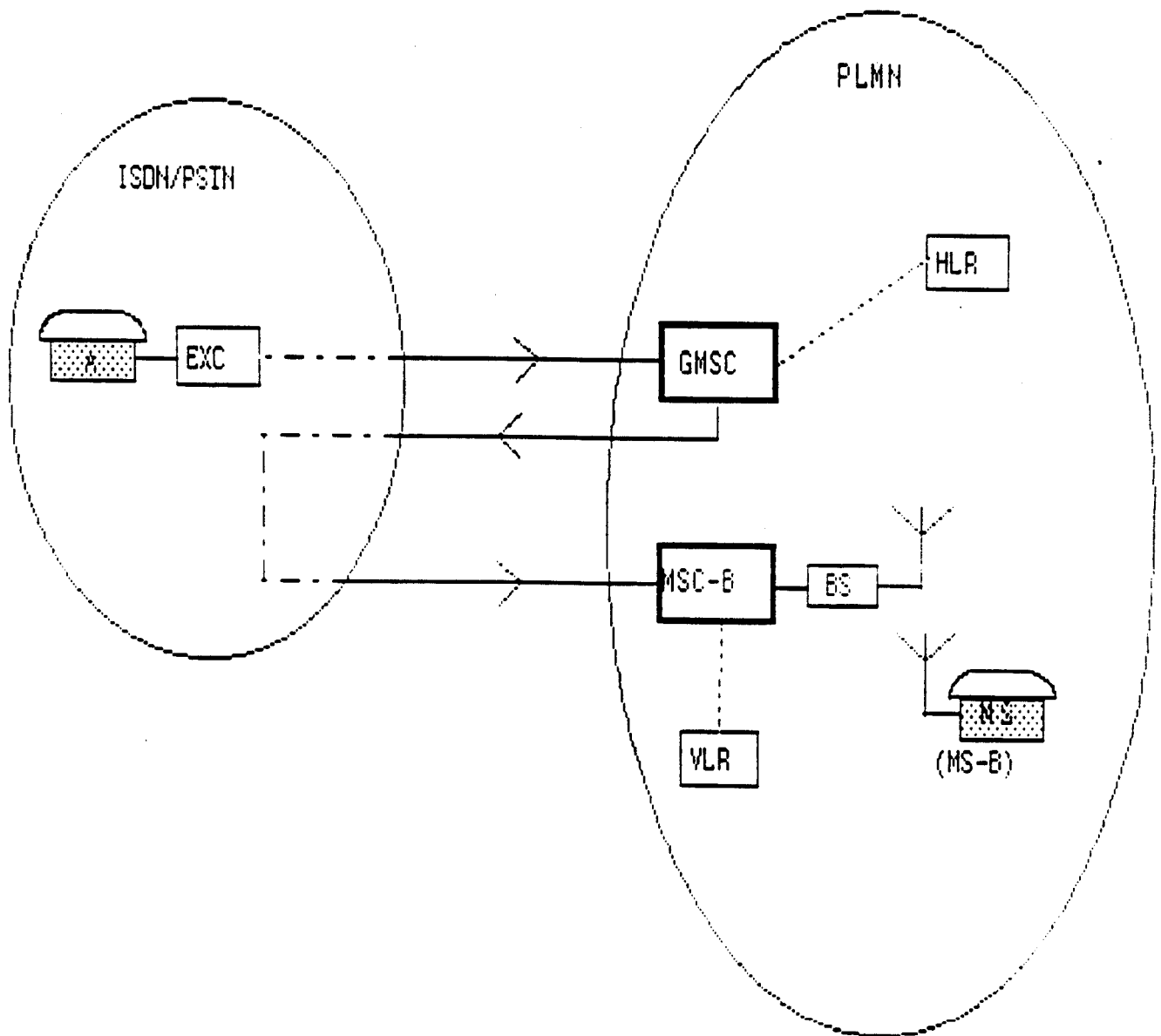


Figure 3.5. Call from ISDN/PSTN

### 3.2.3. Call from ISDN

Figure 3.5 shows a call terminating in a MS from an ISDN subscriber.

It has been assumed that the ISDN does not have the ability to interrogate the HLR. As a consequence call set-up has to be made first to the GMSC in the terminating PLMN. The GMSC asks the HLR to return the Mobile Station Roaming Number, which is then used for routing the call to MSC-B. MSC-B pages MS-B and sets up the call to it. The connection between the GMSC and MSC-B may be in the national ISDN/PSTN or in the international ISDN/PSTN if MS-B has roamed to a third PLMN. The connection between the GMSC and MSC-B may go through several national or international transit exchanges of the ISDN/PSTN.

### 3.2.4. Call from PDN

The routing of calls from PDNs is described in recommendation GSM 03.70.

### 3.3. Short Message Transfer

The MSC functions to support Short Message transfer are indicated in recommendation GSM 03.40.

The GMSC and MSC in 3.3.1 may be the same equipment.

The IWMSC and the MSC in 3.3.2 may be the same equipment.

#### 3.3.1. MS terminated short messages

A GMSC function is required to derive the routing for the Short Message and manage the response to the outcome. The GMSC concerned must receive the short message from the Service Centre (SC), inspect the parameters received and check for errors, interrogate the HLR to find the location of the MS, transfer the short message to the MSC involved, receive the reported outcome from the MSC, and report the outcome to the SC whether successful or not. If the short message fails the GMSC must also request the HLR to store the SC address among its Messages Waiting Data for that MSISDN.

When the HLR determines that the subscriber is now available again it will indicate to an IWMSC which will indicate to the SC that the SMS can be attempted again.

The MSC concerned must receive the short message from the GMSC, retrieve the call setup parameters from the VLR, setup the call to the MS, transfer the message to the MS, receive an indication of outcome from the MS and send a report to the GMSC about the outcome.

The MSC is not involved with Cell Broadcast SMS which is a matter only for the OMC and the BS.

#### 3.3.2. MS originated short messages

The MSC concerned must receive the short message from the MS, inspect the parameters received and check for errors, examine the destination address of the short message, transfer the short message to the interworking MSC (IWMSC), receive the reported outcome from the IWMSC, report the outcome to the MS.

The IWMSC must receive the short message, examine the destination address of the short message, transfer the short message to the destination SC, receive the reported outcome from the SC, report the outcome to the MSC.

#### 4. NUMBERING SCHEME

##### 4.1. General

In order to support the different types of calls and signalling messages the Mobile Services Switching Centre must know the different identification numbers and addresses of the associated networks or PLMN entities.

The following recommendations describe in detail the numbering scheme for the MSC in the PLMN:

GSM.REC	Title
03.02	Network Architecture
03.03	Numbering, Addressing and Identification
03.09	Handover Procedures
03.40	Technical Realisation of the Short Message Service. Point-to-point
03.70	Routing of Calls to/from PDNs
08.08	BSS-MSC Interface Layer 3 Specification
09.02	Mobile Application Part
09.03	Signalling Requirements on Interworking between the ISDN or PSTN and the PLMN
09.04	Interworking between the PLMN and the CSPDN
09.05	Interworking between the PLMN and the PSPDN for PAD access
09.06	Interworking with PSPDN - Synchronous
09.07	General requirements on Interworking between the PLMN and the ISDN or PSTN

## 4.2. Addressing and Identification

### 4.2.1. MS

For addressing and identification of a MS the MSC uses the following numbers:

- \* MSRN : Mobile Station Roaming Number  
(support and use - mandatory)
- \* IMSI : International Mobile Subscriber Identity  
(support and use - mandatory)
- \* TMSI : Temporary Mobile Subscriber Identity  
(support - mandatory)
- \* MSISDN : Mobile Station International ISDN number  
(support and use - mandatory)
- \* MSIDN: Mobile Station International Data Number  
(support - optional)

For detailed information see recommendation GSM 03.03.

### 4.2.2. BSS

The MSC identifies and addresses the Base Station System (BSS) using the Cell Identity (CI) (support and use - mandatory)

For detailed information see recommendations GSM 03.03 and 08.08.

#### 4.2.3. Location area

The MSC identifies its paging areas by using the location area identification (LAI) This is stored into the VLR at location updating and received from the VLR to identify the area where the MS shall be paged. (support and use - mandatory)

For detailed information see recommendation GSM 03.03.

#### 4.2.4. MSC

Addressing and identification of other MSCs is a national matter.

For detailed information see recommendation 09.02.

#### 4.2.5. HLR

For interrogating the HLR, the GMSC uses the Signalling Connection Control Part (SCCP) address derived from the mobile subscriber international ISDN number. (support and use - mandatory)

To transmit the charging information the MSC uses the SCCP address given by the VLR.

For detailed information see recommendation GSM 09.02.

#### 4.2.6. VLR

Addressing and identification of the VLR is a national matter.

For detailed information see recommendation GSM 09.02.

#### 4.2.7. Emergency Centre

The MSC may know the national addresses of the associated emergency centres to route emergency calls to these entities.

#### 4.2.8. Short Message Service Centre

Either the MSC receives the address of the SC in the short message or if it is omitted the MSC itself would decide the recipient SC.  
(support - optional)

For detailed information see recommendation GSM 03.40.

#### 4.2.9. Equipment identity register

For identification of the mobile equipment the MSC must know the national address of the equipment identity register.  
(support - optional)

For detailed information see recommendation GSM 09.02.

#### 4.2.10. Interworking units

Addressing and identification of interworking units is a national matter.  
(support - optional)

For detailed information see recommendation GSM 03.02.

#### 4.2.11. Terminals connected to exchanges of the PSTN, ISDN, PDN or PLMN

The address information received from a MS is used for establishment of this connection  
(support and use - mandatory)

For detailed information see CCITT Recommendations E.163, E.164 and X.121 and Recommendation GSM 03.03.

#### 4.2.12. Exchanges in the fixed network(s)

The MSC addresses the fixed network exchanges according to the normal national rules.

## 5. TYPES OF CALL ROUTING

### 5.1. General

The Mobile Services Switching Centre (MSC) provides all necessary functions for routing different types of calls.

The MSC must analyze received information from other networks or PLMN entities in order to route the call. The routing of signalling messages to control calls is covered in section 10.

The following recommendations describe in detail the types of call in the PLMN:

GSM REC.	Title
02.02	Bearer Services Supported by a GSM PLMN
02.03	Teleservices Supported by a GSM PLMN
03.10	GSM PLMN Connection Types
04.08	Mobile Radio Interface Layer 3 Specification



The following recommendations describe in detail the routing functions of the MSC in the PLMN:

GSM REC	Title
03.02	Network Architecture
03.04	Signalling Requirements Relating to Routing of Calls to Mobile Subscribers
03.09	Handover Procedures
03.11	Technical Realization of Supplementary Services - General Aspects
03.40	Technical Realization of the Short Message Service - Point to Point
03.70	Routing of Calls to/from PDNs
08.08	BSS-MSC Interface Layer 3 Specification
09.03	Signalling Requirements on Interworking between the ISDN or PSTN and the PLMN
09.04	Interworking between the PLMN and the CSPDN
09.05	Interworking between the PLMN and the PSPDN for PAD access
09.06	Interworking with PSPDN - Synchronous
09.07	General Requirements on Interworking between the PLMN and the ISDN or PSTN.

## 5.2. Types of Call

The MSC provides a set of bearer capabilities for transmission of information between user and network. Detailed descriptions of these capabilities are given in recommendations GSM 03.10 and 04.08. These capabilities support the bearer services and the teleservices described in recommendations GSM 02.02 and 02.03.

The different services enable the subscriber to set up the following types of call:

- \* Speech
- \* Short Message
- \* Data

## 5.3. Call Routing

Depending on the received information the MSC has to choose the relevant routing function in order to establish the call.

The circuit allocation between MSC and the BSS for mobile terminating calls and mobile originating calls is performed by the MSC.

The circuit allocation to the fixed network is performed by the normal national routing functions.

If the MSC receives one of the following numbers at call setup, the appropriate routing rules apply, viz:

i) Emergency Service Number

The MSC routes emergency calls to the appropriate emergency centres.

ii) Service Centre Number

The MSC routes the short message call to the required Service Centre.  
For detailed information see recommendation GSM 03.40.

iii) Mobile Station Roaming Number

After interrogation of the HLR the MSC routes the call using the received MSRN to the MSC where the mobile station is actually located.  
For detailed information see recommendation GSM 03.04.

iv) Mobile Station International ISDN Number

For national calls the MSC should be able to interrogate the HLR of the called subscriber in order to obtain the MSRN for routing. For international calls the MSC detects from the international prefix of the mobile station international ISDN number, that the call is destined for another country. The MSC routes the call directly to the corresponding International Switching Centre.  
For detailed information see recommendation GSM 03.04.

v) ISDN/PSTN Number

For national calls the MSC routes the call directly to an ISDN/PSTN exchange. If the international prefix has been dialled, the MSC routes the call to the corresponding International Switching Centre.  
For detailed information see recommendations GSM 03.04 and 09.07.

vi) Mobile Station International Data Number

The structure of this number is defined in recommendation GSM 03.03.  
For detailed information see recommendation GSM 03.70.

5.3.3 Call Routing due to Handover

The call is routed to the adjacent MSC responsible for the target cell.  
For detailed information see recommendation GSM 03.09.

6. SUPPORT OF MOBILE SUBSCRIBER SERVICES

6.1. General

The mobile subscriber services are classified in recommendation GSM 02.01. All the services, which are available to the subscriber, are covered by Telecommunication Services defined in Recommendations GSM 02.02, 02.03 and 02.04 (Table 6.1).

Table 6.1 Telecommunication Service Definitions

GSM.Rec.	Title
02.01	Principles of Telecommunication Services Supported by a GSM PLMN
02.02	Bearer Services Supported by GSM PLMN
02.03	Teleservices Supported by a GSM PLMN
02.04	General on Supplementary Services

To make Telecommunication Services possible there must be terminal and network capabilities (Fig. 6.1). Network capabilities are dependent on the capabilities of the GSM PLMN and the capabilities of other networks to which the GSM PLMN is connected. GSM PLMN (and other networks too) must provide the connection that supports the attributes of the Telecommunication Service requested.

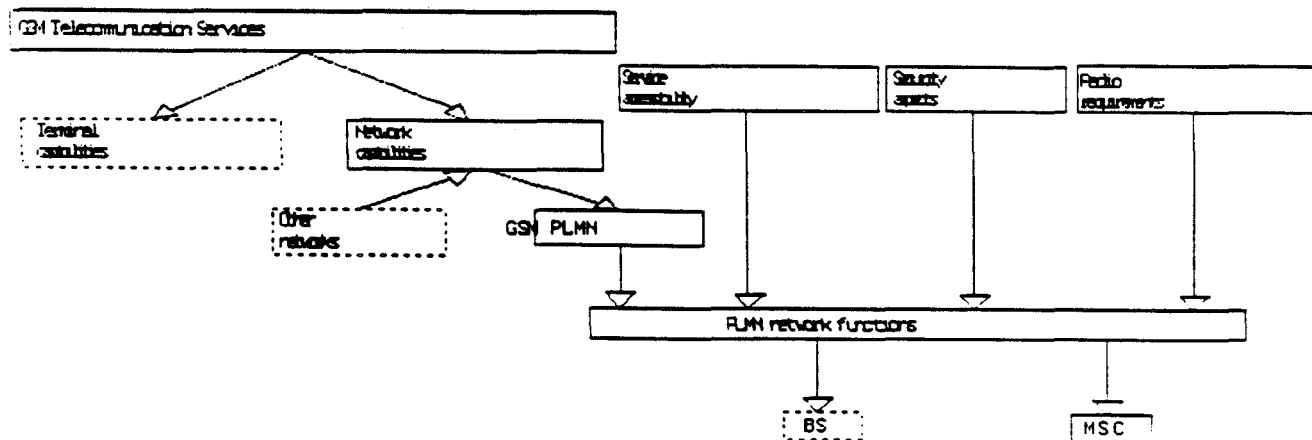


Figure 6.1. The derivation of MSC functions

In mobile telecommunication systems, Telecommunication Services have additions which can be seen to be a kind of supplementary service. The most important addition is that the service is available at international level. GSM defines a GSM System Area, which is accessible by GSM mobile stations. Further, when a communication has been established, a subscriber will normally not suffer any interruptions in service when he is moving etc. The overall definitions of these matters, which are typical for cellular operation, are given in Recommendation GSM 02.11, Service Accessibility.

One service, which cannot be offered as a stand alone service, but which upgrades basic telecommunication services, is security. The use of radio-communications makes the system vulnerable to the misuse of its resources by unauthorized persons and to eavesdropping on the information transferred on the radio path. Therefore GSM has defined security features for the GSM PLMN, which are defined in Recommendation GSM 02.09, Security Aspects.

In addition to service accessibility and security aspects there are some functions that the network might perform because of the use of radio resources such as queuing and OACSU (Off-AirCall-Set-Up).

In order to support the Telecommunication Services, Service Accessibility, Security Aspects and Radio Requirements, the GSM PLMN must perform the network functions listed in Recommendation GSM 03.01, Network functions (See fig. 6.1).

In the following sections all the network functions are considered from the MSC point of view. The role of the MSC in each function is identified.

## 6.2. Call handling

The call handling functions enable the connection establishment between the PLMN and other networks. The general description of the functions of the MSC in call establishment is given in section 3. The detailed specification is given in the recommendations shown in table 6.2.

Table 6.2 Call handling definitions

Recommendation	Title
GSM 03.40	Technical Realization of the Short Message Service point-to-point
GSM 03.70	Routing of Calls to/from PDNs
GSM 04.08	Mobile Radio Interface layer 3 Specification
GSM 08.08	BSS to MSC Interface layer 3 Specification
GSM 09.02	Mobile Application Part
CCITT Q.721 -Q.725	Telephone User Part
GSM 09.07	General Requirements on Interworking between the PLMN and the ISDN or PSTN
GSM 09.09	Detailed signalling Interworking within the PLMN and with the PSTN/ISDN
GSM 09.10	Information Element Mapping between MS-BSS/BSS-MSC Signalling Procedures and the MAP
GSM 09.11	Signalling Interworking for Supplementary Services

The recommendations listed in table 6.2 define the signalling at the highest level. The signalling as a whole from the MSC point of view is defined in chapter 10. Instead of Telephone User Part (TUP) there can be other user parts when communicating with other MSCs and the fixed network.

### 6.3. Subscriber authentication

Subscriber authentication is a mandatory function in the GSM PLMN.

The MSC is transparent for the subscriber authentication procedure, see Recommendation GSM 09.02 and 09.10. The MSC must, however, perform an interworking function as described in Recommendation GSM 08.08 and 09.10 in order to pass the ciphering key (Kc) to the BSS.

Note: See Recommendation GSM 03.20 for the use and definition of the key Kc

### 6.4. Emergency calls

Handling of emergency calls is a mandatory function for the MSC.

After having received an emergency call setup message, the MSC must route the call to an appropriate emergency centre.

Recommendation GSM 04.08 defines the emergency call establishment procedure with the MS.

### 6.5. Supplementary services

Provision of supplementary services within a PLMN is a national matter.

The functions required in the MSC for supporting each supplementary services are given in Recommendation GSM 03.11.

### 6.6. Queuing

Queuing is an optional function in the GSM PLMN. Queuing of MS originating calls and queuing of MS terminating calls can be realized separately.

The location of queuing functions is not defined in GSM Recommendations. They can be either in the MSC or in the BSS. The function to be performed is defined in Recommendations GSM 03.01 and 04.08.

### 6.7. Off-air-call-set-up

Off-air-call-set-up (OACSU) is an optional function in the GSM PLMN.

OACSU is realized with the procedures defined in Recommendation GSM 04.08. There are restrictions in use of OACSU, which are listed in Recommendation GSM 03.01; these impose requirements on the MSC.

### 6.8. Security related services

Security related services are mandatory in the GSM PLMN.

Security related mobile subscriber services are user identity and user data confidentiality.

#### 6.8.1. Subscriber identity confidentiality

Subscriber identity confidentiality is a mandatory function in the GSM PLMN.

Subscriber identity confidentiality is based on the use of Temporary Mobile Subscriber Identity (TMSI). The TMSI is allocated by the VLR. It is normally used in all signalling with the MS. The MSC must store the TMSI in the call setup procedure, because it is the only means to identify a call

#### 6.8.2. User data confidentiality

User data confidentiality is a mandatory function in the GSM PLMN.

This function provides the confidentiality of the user data transmitted on a traffic channel. Encryption/decryption of the user data is done in the MS and in the BSS. The MSC transfers the ciphering key to be used from the VLR to the BSS. (The same ciphering key is used for this and signalling information element confidentiality.)

### 6.9. Discontinuous reception

Discontinuous reception (DRX) is a mandatory function in the network and an optional function in the MS.

A MS may power down its RF and control circuitry to reduce current consumption. Further details are found in Recommendation GSM 03 13



#### 6.10. Dual tone multi frequency signalling

DTMF signalling is a mandatory function in the GSM PLMN.

The reception and acknowledgement of dual tone multi frequency signalling (DTMF) messages from the MS and the generation of DTMF tones towards the network is defined in Recommendation GSM 03.14.

#### 6.11. Location registration

Location registration is a mandatory function (support and use) in the PLMN.

The procedures and functions related to location registration are defined in Recommendation GSM 03.12. The MSC is transparent for location registration except that the identity of the new location area must be inserted in the MAP message sent to the VLR, see Recommendation GSM 09.10.

#### 6.12. Handover

Recommendation GSM 03.09 describes the functions of MSCs for performing handover. A MSC must be capable of controlling handover (MSC-A) and of being handed over to (MSC-B). The MSC to BSS procedures for handover are defined in Recommendation GSM 08.08. The MAP procedures for handover between MSCs are defined in Recommendation GSM 09.02. The interworking between the various procedures on the BSS-MSC interface and the MSC-fixed network interface is described in Recommendation GSM 09.09. Mapping of information elements between messages in Recommendation GSM 08.08 and GSM 09.02 is defined in Recommendation GSM 09.10.

#### 6.13 Short Message Handling

Routing and intermediate buffering of messages for the point-to-point short message service is a mandatory function of the MSC and specified in Recommendation GSM 03.40.

For the transfer of the short messages between the different network elements and the MSC, see Recommendation GSM 09.02.

## 7. INTERFACES

### 7.1. General

The Mobile Services Switching Centre has interfaces to the following:

- a. Other networks - including
  - PSTN/ISDN
  - PDN
  - other PLMNs
- b. Other MSCs within the PLMN
- c. Base Station Systems (BSS)
- d. Registers
  - Home Location Register (HLR)
  - Visitor Location Register (VLR)
  - Equipment Identification Register (EIR)
- e. Operations and Maintenance Centres (OMCs)
- f. Emergency Service Centre
- g. Short Message Service Centre (SC)

The MSC will also provide the necessary functions for maintaining PLMN network synchronization, the MSC will provide synchronization to its associated Base Stations.

A detailed description of the signalling procedures for use on these interfaces is given in section 10 - Signalling System Specification.

The following recommendations describe in detail the interface requirements for the MSC in the PLMN:

GSM Rec.	Title
03.02	Network Architecture
03.05	Technical Performance Objectives
03.11	Technical Realization of Supplementary Services. General aspects
03.40	Technical Realization of the Short Message Service point-to-point.
04.22	Radio Link Protocol for Data and Telematic Services on the MS-BSS Interface and the BSS-MSC interface.
08.01	BSS-MSC Interface - General Aspects
08.02	BSS - MSC Interface - Interface Principles
08.04	BSS - MSC Interface Layer 1
09.02	Mobile Application Part
09.03	Signalling Requirements on interworking between the ISDN or PSTN and the PLMN
09.04	Interworking between the PLMN and the CSPDN
09.05	Interworking between the PLMN and the PSPDN for PAD access.
09.06	Interworking with PSPDN - Synchronous
09.07	General Requirements on Interworking between the PLMN and the ISDN or PSTN
12.01	Common Aspects of GSM Network Management
12.07	Operations and Performance Management
12.20	Network Management Procedures and Messages

The subsequent sub-sections of this interface specification make reference to the relevant areas of the above documents for detailed descriptions of the interfaces.

7.2. MSC Interface to the Signalling System No.7 Network

The following Signalling Interfaces are required:

i.) Between MSC and HLR

Within a PLMN this interface is a national matter and would normally use the Signalling Network. Between PLMNs this interface is mandatory and must use the Signalling Network.

ii) Between MSC and VLR

This interface is a national matter but if implemented separately it would normally use the Signalling Network.

iii) Between MSC and EIR

This interface is a national matter but if implemented separately it would normally use the Signalling Network.

iv) Between MSC and MSC

Within the same PLMN this interface is a national matter. Between PLMNs the interface must use the Signalling Network.

v) Between MSC and OMC

This interface is a national matter.

vi) Between the MSC and the Fixed Network Exchange

Refer to 7.3

The interface to the Signalling Network is implemented using the interface described in Recommendation GSM 09.03. The interface is based on a 2.048 Mbs digital transmission, using a 32 x 64 Kbs frame structure. The transmission aspects are specified in CCITT recommendation G.704 and G.706. The signalling requirements for this interface are described in Section 10.

### 7.2.1. Upper Levels of the interface between MSC and other PLMN entities

The Signalling Connections are defined within the CCITT No.7 Signalling Connection Control Part (SCCP) defined in CEPT T/S 43.03. The SCCP together with Transaction Capabilities supports the Mobile Application Part (MAP), see section 10.

### 7.3. MSC interface with Other Networks

Various aspects of interworking common to all MSC interfaces with other networks are covered in GSM recommendations as follows:

GSM Rec	Item Described
02.02	Bearer Services
02.03	Teleservices
03.10	Connection Types
03.11	Supplementary Service Interworking
03	Signalling Interworking
03.14	Interworking between the PLMN and the CSPDN
09.05	Interworking between the PLMN and the PSPDN for PAD access
09.07	General requirement on Interworking between the PLMN and ISDN or PSTN

Bearer Services (02.02) are described using a series of non-related attributes e.g. Information transfer attributes, Access attributes, Interworking attributes, General attributes. A number of bearer service categories are then defined, e.g.

- Circuit Mode Unstructured "16 Kbs" Unrestricted digital capability transparent
- Packet Mode Service transparent
- Packet Mode Service non transparent
- Alternate Speech/Unrestricted Digital transparent
- etc...

Teleservices (02.03) are described listing the attributes constituting a teleservice. The recommendation lists the various teleservices according to dominant attribute and category of teleservice with the recommended provision. The individual teleservices are then defined. Examples of Teleservices are - Telephony; Emergency Calls; Short Message types; MHS access; Videotex types; Teletex types; Alternate Speech and Facsimile (group 3).

Connection Types (03.10) (i.e. descriptions of sets of GSM PLMN connections categorised by characteristics). The connection types are specified as a series of attributes e.g. - Information transfer mode, Information transfer rate, Establishment of connection, Structure etc.

Signalling Interworking (09.03) see section 10 - Signalling System.

Supplementary Service Interworking (03.11) Technical Realization of Supplementary Services are described in recommendation GSM 03.11. The implementation of Supplementary Services are also described in section 6.

#### 7.3.1. MSC to PSTN/ISDN

The requirement to interwork between these two networks is a national matter.

A detailed description of interworking between the PLMN and PSTN/ISDN is given in recommendation GSM 09.07 where the following subjects and the base attributes of the interface are identified.

Subject	Subject Attributes
Network Characteristics	User - Network Signalling User - Terminal Equipment Supported Inter-Exchange Signalling Transmission Facilities Exchange Types Information Transfer Mode Information Transfer Capability
Interworking Classification	Service Interworking, nothing specific identified for GSM Network Interworking <ul style="list-style-type: none"> <li>- Bearer Service Interworking</li> </ul> Signalling interworking <ul style="list-style-type: none"> <li>- refer rec. GSM 09.03</li> </ul> Supplementary Service Interworking <ul style="list-style-type: none"> <li>- refer - rec.GSM 03.11</li> </ul>
Compatibility Checking	Low Layer Compatibility High Layer Compatibility
Interworking to PSTN	Speech Calls Data Calls Interworking Alternate Speech/Data Calls
Interworking to ISDN	Speech Calls Data Calls

### 7.3.2. MSC to PDNs

PLMN to PSPDN and CSPDN interworking are a national matter.

#### 7.3.2.1. MSC to PSPDN

A detailed description of interworking between PLMN and PSPDNs is given in recommendation GSM 09.05, and 09.06.

#### 7.3.2.2. MSC to CSPDN

A detailed description of this interface is given in recommendation GSM 09.04.

#### 7.4. MSC to Radio Subsystem (BSS) Interface

This is designated as the 'A' interface and is a mandatory interface as described within the GSM 08 series recommendations.

08.01	General Aspects
08.02	Interface Principles
08.04	Layer 1 - Structure of Physical Circuits

Other aspects of signalling interchange over this interface are specified in section 10 "Signalling System" and are described in detail in the 08 series of the GSM recommendations.

##### 7.4.1. Bearer Circuit

The main attributes and status of the bearer Circuit are:

Attribute	GSM rec	Status
Layer 1 Specification	08.04	Mandatory
Analogue Layer 1; data conveyed via modem	08.01	Optional
Interface Principles	08.02	Mandatory with option as given below
Continuity check on analogue links	08.02	
O&M functions as specified for all BSSs	08.01	Mandatory
O&M functions as specified by network operator	08.02	Optional



#### 7.4.2. Bearer Circuit for Non-voice Services

In addition to the specification for the Bearer Circuit as given in 7.4.1 the conveyance of data services (both transparent and non-transparent) requires the procedures described in GSM Recommendation 08.02.

The bearer services to support data services are listed in recommendation GSM 02.02 with their status (refer to recommendation GSM 01.06 for definitions of 'E' phases). Where data services are supported, they should conform to the requirements in recommendation GSM 08.02.

#### 7.4.3. Non-Transparent Data Services

In addition to the specification for the bearer circuit as given in 7.4.2, the conveyance of non-transparent data services requires the following additional attributes:

A Radio Link Protocol (RLP) has been specified for the GSM system which has been optimised for the characteristics of the Radio Link to provide a satisfactory grade of service between the MS and the MSC. This is defined in recommendation GSM 04.22. The RLP is applied at layer 2 and performs error control and retransmission functions enabling more efficient usage of the digital radio transmission link.

Interworking functions to convert between the RLP and the user's data link protocols are located in both the MS and the MSC and (for reason of better presentation) are defined in those recommendations concerning terminal adaptors i.e. GSM 07.02 for asynchronous protocols and GSM 07.03 for synchronous protocols.

#### 7.4.4. Dimensioning of Signalling and Traffic Channels

(Not to be specified by GSM)

#### 7.5. MSC Interface to OMC

See Signalling System section 10

This interface is a national matter. The following recommendations describe various aspects of this interface.

Rec	Title
GSM 12.00	Objectives and structure of Network Management
GSM 12.01	Common Aspects of GSM Network Management
GSM 12.03	Security Management
GSM 12.04	Performance Data Measurements
GSM 12.05	Subscriber related event and call data
GSM 12.06	GSM Network Change Control
GSM 12.07	Operations and Performance Management
GSM 12.13	Maintenance of the Mobile Services Switching Centre
GSM 12.20	Network Management Procedures and Messages

#### 7.6. MSC Interface to Emergency Centres

Interfaces between the MSC and these service centres are a national matter.

#### 7.7. MSC Interface to Short Message Service Centres (SMS SCs)

Service Centres (SCs) for the store and forward of Short Messages in the Short Message Service are defined in recommendation GSM 03.40. A Service Centre may be appended to either the home or visited PLMN, or another network. The access to any particular SC will thus use the interface to the required resident network (see interfaces to other networks in this section).

#### 7.8. Synchronization

Each MSC must be synchronized with the fixed network to which it is connected. The requirements of CCITT recommendation Q.541 should be observed.

Synchronization between the BSS and the MS is described in recommendation GSM 05.10.

Synchronization within the PLMN is a national matter.

## 8. DATA COLLECTION

In addition to the data collection process a digital exchange has to support in a fixed network, the MSC has additional requirements to cope with the mobile nature of the subscribers and the GSM system concept.

The following recommendations describe in detail the data collection requirements for an MSC in a GSM PLMN.

GSM Rec.	Item Described
02.20	Charging mechanisms for collection charges
12.04	Traffic, signalling and performance data collection
12.05	Generation of Call Records
12.06	Data required for change control
12.07	Performance management data and network status information

9. OPERATION AND MAINTENANCE

Network management requirements (functions and physical implementation) in general and the O&M aspects for the MSC in particular are a national matter and therefore do not need to be specified by GSM.

However, in addition to recommendation CCITT Q.542, GSM has agreed to standardize a number of operations and maintenance principles (laid down in the 12 series of GSM recommendations) which network operators are invited to follow. For the O&M aspects of the MSC addressed in the 12 series of recommendations. see table 9.1.

GSM Rec.	Item Addressed
12.00	Objectives, structure and principles of network management
12.01	Signalling system for network management
12.06	System configuration and system change control
12.07	Operation and performance management
12.13	Maintenance of the MSC and the different interfaces

Table 9.1 GSM RECOMMENDATIONS ADDRESSING O&M ASPECTS OF THE MSC.

## 10. SIGNALLING SYSTEM

### 10.1. General

The MSC has to provide the following signalling functions, to support its operation:

- a. The transport of signalling information;
- b. Call Control;
- c. Mobility management;
- d. Signalling security;
- e. Administration and maintenance.

The use of Signalling System No 7 is essential to support the Mobility Management functions within and between PLMNs and for signalling between the MSC and its BSSs. Other functions such as call control may be supported by any suitable signalling system, however, to maximise performance of the PLMN and to promote standardization, SS No 7 should be used in preference to other signalling systems.

The following sections identify which of the above functions impact on each signalling relation, referencing the relevant GSM recommendations.

The following GSM recommendations describe in detail the signalling requirements for the Mobile System.

GSM Rec.	Title
03.01	Network Functions
03.04	Signalling Requirements Relating to routing of calls to Mobile Subscribers
03.09	Handover Procedures
03.20	Security Related Network Functions
08.06	Signalling Transport Mechanism between the BSS and MSC
08.08	BSS-MSC Interface Layer 3 Specification
09.01	General Aspects of PLMN Interworking
09.02	CCITT SS No. 7. Mobile Application Part
09.03	Signalling Requirements on interworking between the ISDN or PSTN and the PLMN
12.00	Objectives and Structure of Network Management
12.01	Common Aspects of Network Management
12.13	Maintenance of the Mobile Services Switching Centre

10.2. SS7 Signalling Network Structure

Recommendation GSM 03.02 describes the Network Architecture of the mobile system. The following table summarises which signalling functions are to be provided for each type of MSC signalling interface identified in that recommendation, with references to the appropriate GSM recommendations.

Signalling function	Signalling Interface MSC to:					
	Other MSCs	VLR	HLR	BSS	PSN	OMC
Signalling transport	09.02	09.02	09.02	08.06	(1)	(2)
Call control	(1)			08.08	(1)	(2)
Mobility management	09.02	09.02		08.08		
Signalling security		09.02		02.09 03.20		
Charging			09.02			(2)

Note: (1) National matter, but preferably SS7 based (GSM Recs. 09.01, 09.03)  
(2) National matter.

Within a PLMN only MAP signalling is a GSM matter. To support the MAP the following SS7 services are mandatory:

- a. TCAP - Based upon CCITT Recommendations Q.771-5, and summarised in GSM Rec. 09.02.
- b. SCCP - Based upon CEPT T/S 43.03, and qualified in GSM Rec.09.02.
- c. MTP - Based upon CCITT Recommendations Q.701-4, Q.706-7 and defined in CEPT Rec. T/S 43-01, 1988.

Special versions of the SCCP and MTP are used in the BSS; these are discussed in section 10.3.2 of this report.



10.3. SS7 related functions between MSC and..... :

10.3.1. Another MSC in the same PLMN

The procedures identified in this section necessitate inter-MSC signalling.

For the PLMN to be integrated into the GSM network the MAP procedures identified in the following recommendations are mandatory:

Procedures	GSM Recommendation(s)	Status
Handover	03.01, 03.09, 09.02	Mandatory
Call Control (during handover)	09.02	Mandatory

The signalling used for call control and maintenance of circuits within a given PLMN is a national matter. However, SS7 (ISUP/TUP + /TUP) is preferred to other signalling systems, in order to support the widest possible change of GSM subscriber services, and to maximise performance.

## 10.3.2. BSS

The functions identified in this section necessitate MSC:BSS signalling. Special versions of SS7 MTP and SCCP have been defined for BSSs - see recommendation GSM 08.06. The versions of the MTP and SCCP implemented in the MSC must interwork with the different versions implemented in the BSS, including the maintenance functions of the MTP.

The MSC must "police" messages received from the MS/BSS to prevent fraudulent use of the PLMN signalling network (Recommendation GSM 08.08).

Call Control, Mobility Management, and BSS Management are defined as separate SS7 entities which use the SCCP connection and connectionless services - see recommendation GSM 08.08 for details. They contain the following procedures:

Procedure(s)	GSM Recommendation(s)	Status
Basic call control	08.08	Mandatory
Authentication	08.08, 02.09	Mandatory
Encryption (1)	02.09; Signalling 03.20, 08.08, 08.02 08.02; User Data	Mandatory
Location Registration	08.08	Mandatory
Resource Control	08.08	Mandatory
Handover	08.08	Mandatory
Queuing (2)	08.08	Optional
O&M (3)	08.02, 08.09	Optional

## Notes:

1. See section 10.3.8.
2. BSS may optionally include a switch in which case calls may be queued at the MSC pending a free circuit on the radio interface and the call queuing signals defined in recommendation GSM 08.08 must also be implemented in the MSC. See recommendations GSM 03.01, and 08.08 for details.
3. BSS Management must transfer commands and data between BSS and OMC.

### 10.3.3. Public Switched (PS) Networks

Certain PLMN functions require signalling between an MSC and a PS network.

The signalling used for the control and maintenance of bearers is a national matter. However, considering that such a network can be used to interconnect calls originating/terminating in different PLMNs and that universal support of PLMN subscriber services is an objective, Signalling System No 7 is preferred (ISUP/TUP + /TUP) (See recommendations GSM 09.01 and 09.03).

As a minimum, a fixed network must be able to transport SS7 MAP messages between different PLMNs interconnected via that fixed network, see recommendation GSM 09.03.

Signalling connections may also exist between a MSC and PSPDN to support such functions as credit/debit card validation for handling MS originating calls. Such signalling is currently a national matter, but to facilitate international working, preference should be given to SS7 based protocols (using TCAP).

### 10.3.4. HLR

MAP signalling is required between MSC and HLR to support the following procedures, to enable a PLMN to be integrated into the GSM network:

Procedure(s)	GSM Recommendation	Status
(Gateway) MSC interrogation of the HLR for routing calls to a MS	09.02	Mandatory
Transfer of charging - information to the HLR after call termination	09.02	Optional (1)

**Note:**

(1) Whether or not such information is transported across PLMN boundaries is a national matter, bilateral agreements may apply.

10.3.5. VLR

A number of functions require signalling between a MSC and its VLR. The VLR may be integrated with a MSC (this is a national matter) but if the VLR is separate then the following MAP procedures must be provided:

Procedure(s)	GSM Recommendation(s)	Status
Location Registration	09.02	Mandatory
IMSI Attach/Detach	09.02	Optional
Supplementary Service Operation	09.02	Mandatory
Retrieval of subscriber parameters for call set-up	09.02	Mandatory
Search for MS	09.02	Mandatory
Authentication	09.02	Mandatory

10.3.6. EIR

There is a need for a MSC to check an IMEI received from a MS; this may be done by interrogating an EIR (see recommendation GSM 09.02)

Within a PLMN the signalling between the MSC and EIR is a national matter, but to facilitate standardization and integration of PLMNs into the GSM network, MAP signalling is preferred.

10.3.7. OMC

The signalling used to provide information transfer between an MSC and OMC is a national matter. However, international standards are emerging which will facilitate the transfer of such information between MSCs and different OMC implementations, using standard protocols. These standards will be embodied in the Telecommunications Management Network (TMN) concept, this is described in recommendation GSM 12.00. Recommendations GSM 12.01 and 12.13 define information transfer principles with other O&M entities.

It is recommended that these standards be adopted by MSCs when they are available, in order to further the aims of standardization.

#### 10.4. Other signalling systems

Signalling for Call Control between MSCs of the same PLMN or between a MSC and PS Network nodes is not a GSM matter.

However, to meet the quality of service and performance objectives defined by GSM, SS7 signalling is preferred. This will necessitate the use of the MTP to transport the signalling information and the ISUP or TUP for national Call Control, or TUP+ for pan-European Call Control. The following recommendations contain more information:

Signalling type	Recommendation(s)
MTP	CEPT T/S 43-01 1988
ISUP	CCITT Q.761-4 Blue Book 1988
TUP+	CEPT T/S 43-02 1988
TUP	CCITT Q.721-5 Blue Book 1988

The MSC must provide interworking between the various signalling systems used, the definition of the signalling interworking functions is a national matter.

#### 11. TRANSMISSION REQUIREMENTS WITHIN THE MSC

(Not to be specified by GSM)

#### 12. PERFORMANCE OF THE MSC

The performance design objectives of the MSC under two reference loads

Reference load for incoming inter-exchange circuits

Reference load for MS originating calls (including all Dm channel activities)

are part of recommendation GSM 03.05 which contains technical performance objectives that should be met by the fixed infrastructure of GSM PLMNs.

Furthermore, recommendation GSM 12.07 describes additional performance requirements for O&M the MSC should meet, which are specific to a GSM PLMN and normally not included in an exchange operating in a fixed network.

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 MSC structure cross reference and indication of responsibility

<u>Item</u>	<u>Responsibility</u>	<u>GSM.ref</u>
0. Scope		
1. Introduction		
2. MSC Functions	GSM	03.04 03.09 03.12 03.40 03.50 08.02 09.02 09.03
3. Call Establishment		
3.1. MS originating call	)	
3.1.1. Call to PLMN	)	
3.1.1.1. Call to an MS of the same PLMN	)	03.02 03.03
3.1.1.2. Call to a MS of another PLMN in the same country	) GSM	03.04 09.01 09.03
3.1.1.3. Call to a MS of another PLMN in another country	)	09.07 09.09
3.1.2. Call to PSTN	)	
3.1.3. Call to ISDN	)	
3.1.4. Call to PDN	) GSM	03.70 09.04 09.05 09.06
3.2. MS terminating call	)	
3.2.1. Call from PLMN	)	
3.2.1.1. Call from a MS of the same PLMN	)	03.02 03.03
3.2.1.2. Call from a MS of another PLMN in the same country	) GSM	03.04 09.01 09.03
3.2.1.3. Call from a MS of another PLMN in another country	)	09.07 09.09

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3.2.2. Call from PSTN	)	
	)	
3.2.3. Call from ISDN	)	
	)	
3.2.4. Call from PDN		GSM 03.70
3.3. Short Message Transfer	)	
	)	
3.3.1. MS terminated short messages	)	GSM 03.40
	)	
3.3.2. MS originated short messages	)	
4. Numbering Scheme	)	
	)	
4.1. General	)	
	)	
4.2. Addressing and Identification	)	
	)	
4.2.1. MS		GSM )
		)
4.2.2. BSS		GSM )
		)
4.2.3. Location area		GSM )
		)
4.2.4. MSC	National	)03.02
	matter	)03.03
		)03.09
4.2.5. HLR	GSM	)03.40
		)03.70
4.2.6. VLR	National	)08.08
	matter	)09.02
		)09.03
4.2.7. Emergency Centre	National	)09.04
	matter	)09.05
		)09.06
4.2.8. Short Message Service Centre	National	)09.07
	matter	)
		)
4.2.9. Equipment identity register	National	)
	matter	)
		)
4.2.10. Interworking units	National	)
	matter	)
		)
4.2.11. Terminals connected to exchanges of the PSTN, ISDN, PDN or PLMN		)
		)
		)
4.2.12. Exchanges in the fixed network(s)		)
		)

5. Types of Call Routing	)		02.02
	)		02.03
5.1. General	)		03.02
	)		03.04
5.2. Types of Call	)	GSM	03.09
	)		03.10
5.3. Call Routing	)		03.11
	)		03.40
5.4. Call Routing due to Handover	)		03.70
	)		04.08
	)		08.08
	)		09.03
	)		09.04
	)		09.05
	)		09.06
	)		09.07
6. Support of mobile subscriber services	)		
	)		
6.1. General	)		
	)		
6.2. Call handling	)		
	)		
6.3. Subscriber authentication	)		02.01
	)		02.02
6.4. Emergency calls	)		02.03
	)		02.04
6.5. Supplementary services	)		02.09
	)		02.11
6.6. Queuing	)		03.01
	)		03.09
6.7. Off-air-call-set-up	)		03.11
	)	GSM	03.12
6.8. Security related services	)		03.13
	)		03.14
6.8.1. Subscriber identity confidentiality	)		03.40
	)		03.70
	)		04.08
6.8.2. User data confidentiality	)		08.08
	)		09.02
6.9. Discontinuous reception	)		09.07
	)		09.09
6.10. Dual tone multi frequency signalling	)		09.10
	)		
6.11. Location registration	)		
	)		
6.12. Handover	)		
	)		
6.13 Short Message Handling	)		



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7. Interfaces	)	
	)	
7.1. General	)	
	)	
7.2. MSC Interface to the Signalling System No.7 Network	)	
	)	
7.2.1. Upper Levels of the interface between MSC and other PLMN entities	)	02.02
	)	02.03
	)	03.02
	)	03.05
7.3. MSC interface with Other Networks	)	03.10
	)	03.11
7.3.1. MSC to PSTN/ISDN	)	03.40
	)	04.22
7.3.2. MSC to PDNs	)	07.02
	)GSM for	07.03
7.3.2.1. MSC to PSPDN	) Inter-	08.01
	)network	08.02
7.3.2.2. MSC to CSPDN	) and	08.04
	)national	08.09
7.4. MSC to Radio Subsystem (BSS) Interface	) matter	09.02
	) within	09.03
7.4.1. Bearer Circuit	) PLMN	09.04
	)	09.05
7.4.2. Bearer Circuit for Non-voice Services	)	09.06
	)	09.07
	)	12.00
7.4.3. Non-Transparent Data Services	)	12.01
	)	12.03
7.4.4. Dimensioning of Signalling and Traffic Channels	)	12.04
	)	12.05
	)	12.06
7.5. MSC Interface to OMC	)	12.07
	)	12.13
7.6. MSC Interface to Emergency Centres	)	
	)	
7.7. MSC Interface to Short Message Service Centres (SMS SCs)	)	
	)	
7.8. Synchronization	)	
	)	
8. Data Collection	National	02.20
	matter	12.04
		12.05
		12.06
		12.07
9. Operation and Maintenance	National	12.00
	matter	12.01
		12.06
		12.07
		12.13

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10. Signalling System		)	
10.1. General		)	
10.2. SS7 Signalling Network Structure		)	
10.3. SS7 related functions between MSC and..... :		)	
10.3.1. Another MSC in the same PLMN	National matter	)	02.09 03.01 03.04 03.09
10.3.2. BSS	GSM	)	03.20 08.06
10.3.3. Public Switched (PS) Networks	GSM	)	08.08 09.01
10.3.4. HLR	GSM	)	09.02 09.03
10.3.5. VLR	GSM	)	12.00 12.01
10.3.6. EIR	National matter	)	12.13
10.3.7. OMC	National matter	)	
10.4. Other signalling systems	National matter	)	
11. Transmission Requirements within the MSC	National matter	)	
12. Performance of the MSC	National matter	)	03.05 12.07